

CLAIMS

What is claimed is:

1. A system for automatically detecting the presence of an obstacle located within a surveillance area associated with a railroad grade crossing, said system comprising:
  - a transmitter transmitting a signal through the surveillance area;
  - a modulating reflector receiving the transmitted signal, said reflector comprising a phase modulator receiving the received signal and generating a phase modulated signal having a characteristic introduced by the modulating reflector, said modulating reflector transmitting the phase modulated signal through the surveillance area;
  - a receiver located to receive the phase modulated signal; and
  - a processor coupled to the transmitter and to the receiver, said processor configured to process the received phase modulated signal and configured to initiate an action as a function of the characteristic in the received phase modulated signal.
2. The system of claim 1 wherein the processor compares an amount of the characteristic in the received signal to a predetermined threshold or characteristic.
3. The system of claim 1 wherein the characteristic is selected from the following list: an amplitude of a first sideband of the received phase modulated signal; an amplitude of a second sideband of the received phase modulated signal; an energy in a first sideband of the received phase modulated signal; an energy in first, second, and third sidebands of the received phase modulated signal; a frequency of an amplitude peak of a first sideband of the received phase modulated signal; and a frequency of an amplitude peak of a second sideband of the received phase modulated signal.
4. The system of claim 1 wherein the transmitter comprises a frequency modulated carrier transmitter and the receiver comprises a frequency modulated

carrier receiver, the frequency modulated transmitter and the frequency modulated receiver each being responsive and sensitive to a peak of the processed signal.

5. The system of claim 1 wherein the receiving comprises two quadrature receivers or two orthogonal receivers.

6. The system of claim 1, further comprising a passive reflector, wherein the passive reflector is located between the transmitter and the modulating reflector and wherein the passive reflector reflects the transmitted signal received from the transmitter to the modulating reflector.

7. The system of claim 1, further comprising a passive reflector, wherein the passive reflector is located between the modulating reflector and the receiver, and wherein the passive reflector reflects the phase modulated signal from the modulating reflector to the receiver.

8. The system of claim 1 wherein the transmitter transmits a continuous wave microwave signal between 9.2 GHz and 10.6 GHz.

9. The system of claim 1 wherein the phase modulator phase modulates the received signal by creating a phase variation of between 0 degrees and 180 degrees at a frequency from the following frequencies: 4.0 KHz, 4.7 KHz, 5.7 KHz, 6.7 KHz, 9.0 KHz, and 12.0 KHz.

10. The system of claim 1 wherein the processor is configured to initiate an alarm action when the processor fails to detect the characteristic within the received phase modulated signal.

11. The system of claim 1 wherein the processor is configured to initiate a consent action when the processor detects the characteristic within the received phase modulated signal.

12. The system of claim 1, further comprising a timer, wherein the transmitter is responsive to the processor, said processor is configured to receive a gates closed signal and is configured to initiate the transmitter to transmit the transmitted signal upon receipt of a gates closed signal, and said transmitter is configured to continue to transmit the transmitted signal, wherein the processor continues to process the received signal until said timer expires.

13. The system of claim 1, further comprising a preamplifier and a filter coupled between the receiver and the processor, said preamplifier and filter conditioning the received signal prior to said processor processing the received phase modulated signal.

14. The system of claim 1, further comprising a Global Positioning Satellite (GPS) receiver, said GPS receiver providing a time and a position signal to the processor.

15. The system of claim 1, further comprising a memory, wherein the processor stores in said memory the action initiated by the processor.

16. A method for automatically detecting the presence of an obstacle located within a surveillance area associated with a railroad grade crossing; comprising:

transmitting a microwave signal through the surveillance area;  
receiving the microwave signal at a modulating reflector;  
phase modulating the received microwave signal by a phase modulator creating a phase modulated signal containing a characteristic;  
transmitting the phase modulated signal through the surveillance area;  
receiving the phase modulated signal at a receiver;  
processing the phase modulated signal to determine the characteristic within the received phase modulated signal; and  
initiating an action as a function of the determined characteristic of the received phase modulated signal.

17. The method of claim 16 wherein processing the phase modulated signal determines the characteristic in the received phase modulated signal by comparing an amount of determined characteristic in the received phase modulated signal to a predetermined threshold or characteristic.

18. The method of claim 16 wherein phase modulating the signal creates the characteristic from the following list: an amplitude of a first sideband of the received phase modulated signal; an amplitude of a second sideband of the received phase modulated signal; an energy in a first sideband of the received phase modulated signal; an energy in first, second, and third sidebands of the received phase modulated signal; a frequency of an amplitude peak of a first sideband of the received phase modulated signal; and a frequency of an amplitude peak of a second sideband of the received phase modulated signal.

19. The method of claim 16, further comprising receiving the transmitted microwave signal and passively reflecting the microwave signal, wherein the receiving of the microwave signal at the modulating reflector is receiving the microwave signal as passively reflected.

20. The method of claim 16, further comprising:  
receiving the reflected phase modulated signal; and  
passively reflecting the phase modulated signal, wherein the receiving of the signal at the receiver is receiving the phase modulated signal as passively reflected.

21. The method of claim 16 wherein transmitting a microwave signal comprises transmitting a continuous wave microwave signal between 9.2 GHz and 10.6 GHz.

22. The method of claim 16 wherein phase modulating the received microwave signal at the modulating reflector is modulating the received signal by creating a phase variation of between 0 degrees and 180 degrees at a frequency of one of the following frequencies: 4.0 KHz, 4.7 KHz, 5.7 KHz, 6.7 KHz, 9.0 KHz, and 12.0 KHz.

23. The method of claim 16 wherein initiating an action is initiating an alarm action.

24. The method of claim 16 wherein initiating an action is initiating a consent signal.

25. The method of claim 16, further comprising:  
receiving a gates closed signal;  
initiating the transmitter to transmit the transmitted signal upon receipt of a gates closed signal; and  
terminating the transmitter to transmit the transmitted signal upon the expiration of a timer.

26. The method of claim 16, further comprising pre-amplifying and filtering the received phase modulated signal, wherein processing the phase modulated signal is processing the received phase modulated signal as pre-amplified and filtered.

27. The method of claim 16, further comprising receiving data from a Global Positioning Satellite (GPS) receiver that includes the time.

28. The method of claim 16, further comprising storing in a memory the initiated action.